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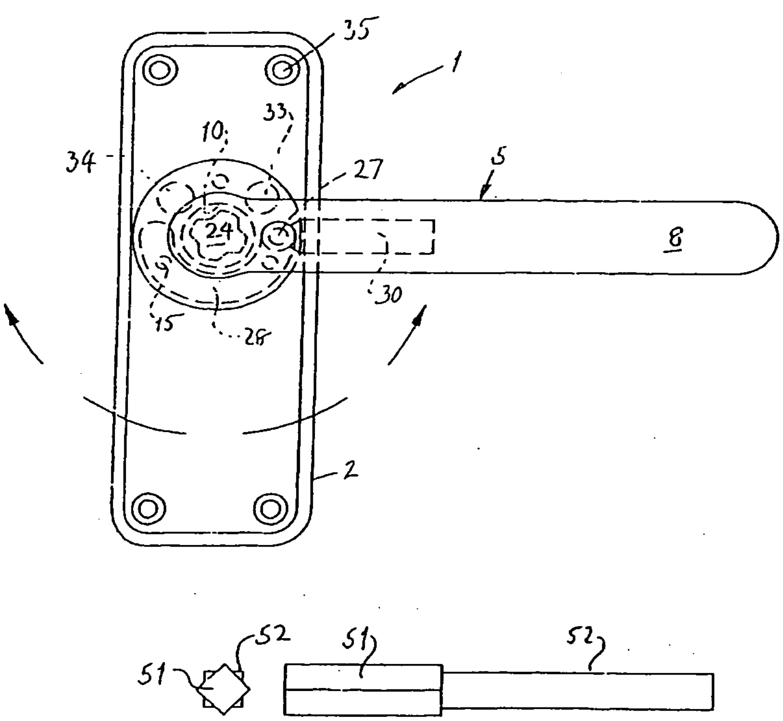
(54) Title: MECHANICAL OSCILLATOR SYSTEM



(57) Abstract: A mechanical oscillator system comprising a balance wheel and a spiral or helicoidal balance spring for use in horological mechanisms or other precision instruments. The balance spring is made of a non-magnetic composite, polymer, carbon or ceramic material, preferably a composite material of carbon fibres in a polymer, carbon or ceramic matrix, and the balance wheel is made from a non-magnetic ceramic. The values of the thermal expansion coefficients for the balance spring and balance wheel are similar, very small and stable over a wide temperature range. The expansion coefficients in the axial sense of the spring and of the balance wheel are of opposite sign and they compensate one another. The density of these materials is smaller than that of the currently used metals. Through this combination of materials it is possible to obtain significant advantages and a higher level of accuracy and stability compared with metal oscillator systems.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

MECHANICAL OSCILLATOR SYSTEM

The present invention relates to a mechanical oscillator system comprising a balance and balance spring for use in horological mechanisms (e.g. timekeeping devices) or other precision instruments. It is thought that it will be particularly applicable to the oscillator system in a mechanical watch, although the present invention is not limited to this.

Previous mechanisms use metal alloys, in particular Fe-Ni or Ni, Cu-Be, Au-Cu alloys, for the balance spring and balance. At its most general, in one of its aspects, the present invention proposes that the balance is made of a non-magnetic ceramic material and the balance spring is non-magnetic and is made of a composite material, or a polymer (including thermoset and thermoplastic polymers, esters and phenolic based resins), carbon or (non-magnetic) ceramic material.

In contrast to metals, the above materials are non-susceptible to the effects of magnetism - including electromagnetic damping and magnetically induced change

of the Young's modulus. These materials have some intrinsic thermal characteristics which are better than metals and so a mechanical oscillator system having reduced variation of oscillator frequency with temperature can be made. Variation with temperature is discussed below in more detail. A balance spring of the above materials may be less susceptible to internal mechanical (e.g. friction) damping of the Young's Modulus, allowing amplitude to be maintained by the balance and a higher frequency of oscillation and therefore a more accurate horological mechanism or precision instrument than a metal spring.

The balance spring is arranged to oscillate the balance. Preferably the balance is a balance wheel; the balance spring may be arranged inside the circumference of the balance wheel so as to oscillate the balance wheel back and forth about its axis of rotation as is conventional. The balance may be coupled to an escapement mechanism for regulating rotation of an escape wheel (which is e.g. coupled to the hands of a watch), as is also conventionally known.

Preferably the balance spring works in flexion to oscillate the balance, most preferably exclusively in flexion. That is the balance spring is preferably not relying on strain or shear properties for the repeated store and release of energy during its (relatively rapid) oscillations. Preferably the balance spring coils are not in contact with each other, i.e. there is a gap between adjacent coils. This eliminates or reduces friction and allows the successive coils to act unhindered by one another.

While the main body of the balance is made of a ceramic material, it may have small appendages of other materials.

Considerations relating to the oscillator frequency and in particular its variation with temperature will now be discussed.

The accuracy of a mechanical watch is dependent upon the specific frequency of the oscillator composed of the balance wheel and balance spring. When the temperature varies, the thermal expansion of the balance wheel and balance spring, as well as the variation of the Young's

Modulus of the balance spring, change the specific frequency of the oscillating system, disturbing the accuracy of the watch. The inventor has noticed that in known systems approximately three quarters of the variation is due to thermal or magnetically induced changes in the balance spring.

Methods for compensating these variations are based on the consideration that the specific frequency depends exclusively upon the relationship between the torque of the balance spring acting upon the balance and the moment of inertia of the latter as is indicated in the following relationship

$$T = 2\pi\sqrt{\frac{I}{G}} \qquad [1]$$

T: the period of oscillation, I: the moment of inertia of the balance wheel, G: the torque of the balance spring.

The moment of inertia of the balance wheel is a function of its masse M and its radius of gyration r.

The torque of the balance spring is a function of its dimensions: length l, height h, thickness e, and of its Young's Modulus E. The length l of the balance spring (which may be helical or spiral form) is the whole length of the spring, end to end, as distinct from e.g. a top to

bottom measurement that varies according to the spacing of the coils.

The relationship [1] is therefore written:

$$T = 2\pi\sqrt{\frac{12.M.r^2.l}{E.h.e^3}} \qquad [2]$$

Temperature variations influence T (the period of oscillation) resulting from the effects of expansion and contraction of the system (balance spring and balance wheel) l, h and e for the balance spring, and r for the balance wheel whose mass m remains constant.

It is known how to compensate for the effects of expansion on l, h and e. However the period of oscillation is still subject to variations of r and E in keeping with the relationship expressed by:

$$\frac{r}{\sqrt{E}} \qquad [3]$$

These two terms are not in a linear relationship.

It is necessary that this relationship should remain as constant as possible (so as to keep the period T of oscillations constant).

Fe-Ni metal spring alloys render an approximate solution when the alloy is perfectly de-magnetised. However, when the alloy is not perfectly demagnetised, the relationship is no longer constant: $\sqrt{E}$ changes.

The currently employed metal alloys for balance springs show an increase in E (which is considered abnormal) and also in l, for an increase in temperature, over the ambient temperature range up to 40°C. The balance wheels currently employed in precision watches are of an Au-Cu alloy with a coefficient of thermal expansion α between +14 and $+17\times10^{-6}/K^{-1}$ to compensate for changes in the Young's modulus of the balance spring.

In summary, the currently used metal alloys despite compensation, only allow for the stability of T (period of oscillation) over a narrow temperature range and only when the balance spring alloy remains un-magnetised. (Any watch currently employing a Fe-Ni balance spring may be stopped by a sufficient magnet).

Preferably the balance spring material comprises continuous fibres extending along the length of the

balance spring from one end of said spring to the other end of said spring.

As the fibres are continuous extending along the length of the balance spring from one end to the other, the degree to which the spring expands (or contracts) with an increase in temperature can be controlled fairly accurately by appropriate choice of the fibre material.

Preferably the continuous fibres are part of a composite material, although it is possible to have a balance spring of continuous fibres in a non-composite material (i.e. without a matrix, e.g. long ceramic fibres).

Where the material is a composite material, preferably the matrix phase comprises a polymer (of any of the types discussed above), carbon or a ceramic. In the case of a composite material with ceramic fibres, the fibres may be continuous fibres extending along the length of the spring from one end of the spring to the other as discussed above, or smaller fibres that do not extend all the way along the spring.

Where ceramic fibres are used (with or without a matrix), it is important that the ceramic is a non-magnetic ceramic. Preferably, but not necessarily, the balance spring ceramic is Alumina-Silica-Boria. Fused quartz or silica may also be used for the balance.

Preferably the thermal coefficient of expansion of the balance and the thermal coefficient of expansion of material of the balance spring, in the direction along the length of the balance spring, are of opposite signs and of similar orders of magnitude (i.e. the difference in magnitude between the two is not more than a factor of 6 and one of the α coefficients should not be greater than $1 \times 10^{-6}\ K^{-1}$). In this way expansion of one can be compensated for by contraction of the other. For example, if said thermal coefficient of expansion of the balance spring is negative and said thermal coefficient of expansion of the balance is positive then with an increase of temperature r increases, but l decreases and in accordance with equation [2] these effects combine to assist in compensating for thermal variation in said period of oscillation T.

Preferably said coefficient of expansion are both very small. For example preferably the coefficient of thermal expansion of the balance is positive and less then $1x10^{-6}K^{-1}$ and the coefficient of thermal expansion of the material of the balance spring in the direction along the length of the balance spring is negative, but greater than $-1x10^{-6}/K^{-1}$.

The variation of E (Youngs Modulus) with temperature is also important and is determined by the thermoelastic coefficient which is a measure of the unit change in Young's Modulus per unit increase in temperature. Preferably the thermoelastic coefficient of the material of the balance spring is negative ; most preferably 1% in the temperature range 0 to 60 degrees Celsius.

In general, the formula for timekeeping changes (U) consequent upon a rise in temperature of 1°C is

$$U=\alpha_1 - 3\alpha_2/2 - \delta E/2E$$

Thus U can be made to tend to zero when suitable values of α_1 (balance coefficient of thermal expansion), α_2 (balance spring coefficient of thermal expansion) and the

thermo-elastic coefficient $\delta E/E$ are selected by selection of appropriate materials.

The tolerances represented by small α_1, α_2 (e.g. less than 6 $\times 10^{-6}$ K^{-1}) and a small thermo-elastic value $\delta E/E$ allow much more readily for U to be kept low.

Preferably the continuous fibres are ceramic fibres or carbon fibres, most preferably carbon fibres having a graphitic carbon structure. Graphitic carbon structure has a negative longitudinal coefficient of thermal expansion. The fibres may for example be produced from a "PITCH" precursor or a polyacrilonitrile "PAN" precursor.

The fibres may be laid parallel to each other along their lengths, or may be twisted together. Twisting the fibres together modulates the coefficient of thermal expansion and Young's Modulus of the balance spring material and may be useful where the fibres have a high and the matrix a low Young's Modulus or coefficient of thermal expansion.

Preferably the coefficient of thermal expansion of the balance spring material in the direction along the length

of the balance spring is linear up to 700° Kelvin. This allows the system to be very stable in the ambient range (0-40°C) and also to compensate for thermal variations over a large range. Preferably said coefficient of thermal expansion is negative.

Preferably the damping of the modulus of elasticity of the balance spring is of the order of 0.001 pa.

Preferably the density of the composite material of the balance spring is less than $3g/cm^3$.

Preferably the balance is formed by high precision injection moulding.

Further aspects of the present invention also provide a horological mechanism or other precision instrument comprising the above described mechanical oscillator system.

An embodiment of the invention will now be described.

A mechanical oscillating system for use in a horological mechanism or other precision instrument comprises a balance, in the form of a balance wheel, and a balance spring arranged to oscillate said balance around an axis of rotation.

The balance wheel is made of a non-magnetic ceramic for which the coefficient of thermal expansion is, positive and less than +6 $\times 10^{-6}$ K^{-1}, most preferably less than 1 $\times 10^{-6}$ K^{-1} . Quartz is one example of a suitable material. Preferably high purity fused quartz is used, fused quartz has a coefficient of thermal expansion of $\leq$ +0.54 $\times 10^{-6}$ K^{-1}. Other alternative ceramic materials include Aluminium Nitride (+5.2), Alumino-Silicate-Glass (+5), Boron Carbide (+5.6), Boron Nitride (+1.6), Silica (+0.75), Silicon hot-pressed or reaction bonded (+3.5) and Zirconia (stabilised) (+5); the numbers is brackets indicate the order of magnitude of the coefficient of thermal expansion of these materials in units $\times 10^{-6}$ K^{-1}

The method of fabrication of the balance wheel may preferably be by high precision injection moulding.

The balance spring is shaped into an Archimedes flat spiral or helicoid form. It is made from a composite material comprising continuous carbon fibres which are either twisted or laid parallel to each other, the fibres being continuous lengths of fibres which extend from one end of the spring to the other along the length *l* of the spring. The fibres are derived according to the stiffness required from the precursor pitch (a mixture of thousands of different species of hydrocarbon and heterocyclic molecules) or polyacrilonitrile 'PAN' (derived from a carbon graphitic structure). The fibres are coated and set in a matrix phase of polymer (thermosetting polymer, thermoplastic polymer, ester or phenolic base resin etc), ceramic or carbon. The composite material acts in a flexural manner. The axial modulus of elasticity of the fibres is between 230 and 1000Gpa. The composite has both a lower density less than $3g/cm^3$ and coefficient of damping of its Young's modulus of the order of (0.001 pa), both less than the currently employed metal alloys. Its thermal expansion coefficient (α) in the direction along the length of the spring remains both negative and stable to 700° Kelvin, and is greater than $-1 \times 10^{-6}\ K^{-1}$.

This composite material is non-magnetic and obviates the negative effects of magnetism. The coefficient of thermal expansion α of the spring is negative and acts in parallel with the spring's Young's modulus which decreases linearly with a rise in temperature and is therefore negative (normal).

The values of the coefficients of thermal expansion (the α coefficients) for the spring and the balance are similar, very small and of opposite sign which further assist in the compensation for temperature variation.

The α coefficient of the spring remains the same over a wide temperature range, and the range of its use between 5° and 40°C represents only 5% at the centre of the total stable temperature range.

Thus, following the relationship:

$$T = 2\pi\sqrt{\frac{12.M.r^2 l}{E.h.e^3}} \qquad [2]$$

the numerator does not increase in value as is the case with the metal alloys when the temperature increases because the α coefficient of the fibre composite in the axial sense l is negative, and therefore it diminishes. The denominator also diminishes when the temperature rises because the thermoelastic coefficient is negative

(normal). Furthermore the height (h) and thickness (e) of the carbon fibre-matrix composite balance spring also increase with temperature which also counteracts the decrease in Young's Modulus E with rising temperature.

By this combination of materials and their mechanical properties it is possible to obtain both greater accuracy and stability. The damping effect of the modulus of elasticity is one tenth of the value of the currently employed metal alloy and the reduced energy losses due to the decreased damping and density of the material allow to envisage maintaining stable amplitude and a significant increase in frequency and significantly reduced total energy losses in the oscillator system.

As has been explained above the present invention can be applied to a conventional mechanical oscillator system in a time keeping device such as a watch. An example of a conventional mechanical oscillator system in a time keeping device is illustrated and described on pages 194 to 195 of "How Things Work", volume 1 published 1972 by Paladin, UK, which is incorporated herein by reference.

Claims

1. A mechanical oscillator system for a horological mechanism or other precision instrument, the system comprising a non-magnetic ceramic balance and a non-magnetic balance spring of flat spiral or helicoidal form, the balance spring being formed of a composite material or a polymer, carbon or ceramic material.

2. A system according to claim 1 wherein said balance spring material comprises continuous fibres extending along the length of the balance spring from one end of said spring to the other end of said spring.

3. A system according to claim 1 or 2 wherein the balance spring is of a composite material and the matrix phase comprises polymer, carbon or ceramic.

4. A system according to any one of the preceding claims wherein the coefficient of thermal expansion of the balance and the coefficient of thermal expansion of the material of the balance spring in the direction along the length of the balance spring are of opposite signs

and of similar orders of magnitude so as to compensate for thermal variation in the system.

5. A system according to claim 4 wherein the coefficient of thermal expansion of the balance is positive and the coefficient of thermal expansion of the material of the balance spring in the direction along the length of the balance spring is negative.

6. A system according to claim 5 wherein the thermal coefficient of expansion of the balance is less than $1x10^{-6}/K^{-1}$ and the coefficient of thermal expansion of the material of the balance spring in the direction along the length of the balance spring is greater than $-1x10^{-6}/K^{-1}$.

7. A system according to any one of claims 2 to 6 wherein said continuous fibres are carbon fibres.

8. A system according to claim 7 wherein said fibres have a graphitic carbon structure.

9. A system according to any one of claims 2 to 8 wherein the fibres are produced from one of the precursors 'PITCH' or polyacrilonitrile 'PAN'.

10. A system according to any one of claims 1 to 9 wherein the balance spring is of a composite material having a coefficient of thermal expansion in the direction along the length of the balance spring, said coefficient of thermal expansion being linear and negative up to 700° Kelvin.

11. A system according to any one of the preceding claims wherein the damping of the modulus of elasticity of the balance spring is of the order of 0.001 Pa.

12. A system according to any one of claims 1 to 4 wherein said balance spring material comprises ceramic fibres.

13. A system according to claim 12 wherein said ceramic fibres have coefficient of thermal expansion which is less than $6 \times 10^{-6} K^{-1}$.

14. A system according to any one of claims 2 to 13 wherein said fibres are substantially parallel to each other.

15. A system according to any one of claims 2 to 13 wherein said fibres are twisted together.

16. A system according to any of the preceding claims wherein the balance spring is a flexion spring configured to work in flexion to oscillate the balance.

17. A system according to any one of the preceding claims the density of the balance spring material is less then $3g/cm^3$.

18. A system according to any one of the preceding claims wherein the balance is formed by high precision injection moulding.

19. A system according to any one of the preceding claims wherein the material of the balance spring has a negative thermoelastic coefficient.

20. A mechanical oscillator system for use in a horological movement or other precision instrument, the system comprising a balance and a balance spring of spiral or helicoidal form, the balance being of a ceramic material and the balance spring of a composite material.

21. A system according to claim 20, wherein the composite material comprises continuous carbon fibres twisted or laid parallel in the sense of the main axis of the fibre according to the stiffness required.

22. A system according to claim 21, wherein according to the modulus of elasticity required, the fibres are produced from one of the precursors "PITCH" or polyacrilonitrioe "PAN".

23. A system according to claim 21 or 22, wherein the fibres are coated in a matrix phase of thermoset polymer, thermoplastic polymer or ceramic.

24. A system according to any one of claims 20 to 23, wherein the balance spring material is not sensitive to the effects of magnetisation.

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G04B17/06 G04B17/22 F16F1/366

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 196 51 321 A (SCHMIDT) 18 June 1998 (1998-06-18) column 1, line 17 - line 25 ---	1
Y	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 01, 30 January 1998 (1998-01-30) & JP 09 257069 A (NIKKISO CO LTD), 30 September 1997 (1997-09-30) abstract ---	1
A	US 5 678 809 A (NAKAGAWA TAKAO ET AL) 21 October 1997 (1997-10-21) abstract ---	1,17
A	US 4 260 143 A (KLIGER HOWARD S) 7 April 1981 (1981-04-07) abstract --- -/--	1

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Pineau, A

31. A system according to claim 20, wherein the balance is fabricated by a method of high precision injection moulding.

32. A system according to claims 20 to 31, wherein the coefficient of thermal expansion of the balance is positive in order to compensate the balance spring which has a negative coefficient of thermal expansion.

33. A system according to any one claims 20 to 32, wherein the balance is not sensitive to the effects of magnetisation.

INTERNATIONAL SEARCH REPORT

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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
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A	US 4 260 143 A (KLIGER HOWARD S) 7 April 1981 (1981-04-07) abstract ---	1

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European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Pineau, A

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 765 602 A (ROESELER WILLIAM G) 23 August 1988 (1988-08-23) abstract	7,8

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Information on patent family members

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WO 2004/008259 A1

(54) Title: MECHANICAL OSCILLATOR SYSTEM

(57) Abstract: A mechanical oscillator system comprising a balance wheel and a spiral or helicoidal balance spring for use in horological mechanisms or other precision instruments. The balance spring is made of a non-magnetic composite, polymer, carbon or ceramic material, preferably a composite material of carbon fibres in a polymer, carbon or ceramic matrix, and the balance wheel is made from a non-magnetic ceramic. The values of the thermal expansion coefficients for the balance spring and balance wheel are similar, very small and stable over a wide temperature range. The expansion coefficients in the axial sense of the spring and of the balance wheel are of opposite sign and they compensate one another. The density of these materials is smaller than that of the currently used metals. Through this combination of materials it is possible to obtain significant advantages and a higher level of accuracy and stability compared with metal oscillator systems.

Original (for **SUBMISSION**) - printed on 09.07.2003 03:22:45 PM

0	**For receiving Office use only**	
0-1	International Application No.	
0-2	International Filing Date	
0-3	Name of receiving Office and "PCT International Application"	

0-4	**Form - PCT/RO/101 PCT Request**	
0-4-1	Prepared using	PCT-EASY Version 2.92 (updated 01.01.2003)
0-5	**Petition** The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	**Receiving Office (specified by the applicant)**	United Kingdom Patent Office (RO/GB)
0-7	**Applicant's or agent's file reference**	DRHFP6155139
I	**Title of invention**	MECHANICAL OSCILLATOR SYSTEM
II	**Applicant**	
II-1	This person is:	applicant and inventor
II-2	Applicant for	all designated States
II-4	Name (LAST, First)	LEVINGSTON, Gideon
II-5	Address:	50 Avenue Francis de Croisset F-06130 Grasse France
II-6	State of nationality	GB
II-7	State of residence	FR
IV-1	**Agent or common representative; or address for correspondence** The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	agent
IV-1-1	Name (LAST, First)	CALDERBANK, T., Roger
IV-1-2	Address:	Mewburn Ellis York House 23 Kingsway London, Greater London WC2B 6HP United Kingdom
IV-1-3	Telephone No.	0117 926 6411
IV-1-4	Facsimile No.	020 7240 9339
IV-1-5	e-mail	roger.calderbank@mewburn.com

IV-2	Additional agent(s)	additional agent(s) with same address as first named agent
IV-2-1	Name(s)	ARMITAGE, Ian, M.; BRASNETT, Adrian, H.; COCHLIN, Rachel, L.; COLEIRO, Raymond; CRIPPS, Joanna, E.; DENISON, Christopher, M.; FORD, Michael, F.; HACKNEY, Nigel, J.; HARRISON, Susan, J.; KIDDLE, Simon, J.; KREMER, Simon, M.; LYONS, June, M.; NAYLOR, Mathew, J.; NICHOLLS, Kathryn, M.; PAGET, Hugh, C.E.; SANDERSON, Michael, J.; STONER, G., Patrick; STUART, Ian; SUTCLIFFE, Nicholas, R.; WALTON, Sean, M.; WATSON, Robert, J.
V	**Designation of States**	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AP: GH GM KE LS MW MZ SD SL SZ TZ UG ZM ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT EP: AT BE BG CH&LI CY CZ DE DK EE ES FI FR GB GR HU IE IT LU MC NL PT SE SI SK TR and any other State which is a Contracting State of the European Patent Convention and of the PCT OA: BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH&LI CN CO CR CU CZ DE DK DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NI NO NZ OM PH PL PT RO RU SC SD SE SG SK SL TJ TM TN TR TT TZ UA UG US UZ VC VN YU ZA ZM ZW

V-5	**Precautionary Designation Statement** In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.		
V-6	**Exclusion(s) from precautionary designations**	NONE	
VI-1	**Priority claim of earlier national application**		
VI-1-1	Filing date	12 July 2002 (12.07.2002)	
VI-1-2	Number	0208802	
VI-1-3	Country	FR	
VII-1	**International Searching Authority Chosen**	European Patent Office (EPO) (ISA/EP)	
VIII	**Declarations**	Number of declarations	
VIII-1	Declaration as to the identity of the inventor	-	
VIII-2	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	-	
VIII-3	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	-	
VIII-4	Declaration of inventorship (only for the purposes of the designation of the United States of America)	-	
VIII-5	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	-	
IX	**Check list**	number of sheets	electronic file(s) attached
IX-1	Request (including declaration sheets)	4	-
IX-2	Description	15	-
IX-3	Claims	7	-
IX-4	Abstract	1	EZABST00.TXT
IX-5	Drawings	0	-
IX-7	TOTAL	27	
	Accompanying items	paper document(s) attached	electronic file(s) attached
IX-8	Fee calculation sheet	✓	-
IX-17	PCT-EASY diskette	-	Diskette
IX-19	**Figure of the drawings which should accompany the abstract**		
IX-20	**Language of filing of the international application**	English	

X-1	Signature of applicant, agent or common representative	
X-1-1	Name (LAST, First)	CALDERBANK, T., Roger

FOR RECEIVING OFFICE USE ONLY

10-1	Date of actual receipt of the purported international application	
10-2	Drawings:	
10-2-1	Received	
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/EP
10-6	Transmittal of search copy delayed until search fee is paid	

FOR INTERNATIONAL BUREAU USE ONLY

11-1	Date of receipt of the record copy by the International Bureau	

To:
Mewburn Ellis
York House
23 Kingsway
London

WC2B 6HP

RECEIVED
29 JUL 2003
MEWBURN ELLIS

COPY

NOTIFICATION OF THE INTERNATIONAL APPLICATION NUMBER AND OF THE INTERNATIONAL FILING DATE

(PCT Rule 20.5(c))

Date of mailing (*day/month/year*) 28 JUL 2003

IMPORTANT NOTIFICATION

Applicant's or agents's file reference
DRHFP6155139

International application No.	International filing date (*day/month/year*)	Priority date (*day/month/year*)
PCT/GB2003/003000	10/07/2003	12/07/2002

Applicant
Levingston, Gideon

Title of the invention
Mechanical Oscillator System

1. The applicant is hereby notified that the international application has been accorded the international application number and the international filing date indicated above.

2. The applicant is further notified that the record copy of the international application:

- [x] was transmitted to the International Bureau on 28 JUL 2003
- [ ] has not yet been transmitted to the International Bureau for the reason indicated below and a copy of this notification has been sent to the International Bureau*:
  - [ ] because the necessary national security clearance has not yet been obtained.
  - [ ] because *(reason to be specified)*:

* The International Bureau monitors the transmittal of the record copy by the receiving Office and will notify the applicant (with Form PCT/IB/301) of its receipt. Should the record copy not have been received by the expiration of 14 months from the priority date, the International Bureau will notify the applicant (Rule 22.1(c)).

Name and mailing address of the receiving Office	Authorized officer
The Patent Office Cardiff Road, Newport South Wales NP10 8QQ Facsimile No.	Kelly Sheppard Telephone No. 01633 814589

Form PCT/RO/105 (July 1992)

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF RECEIPT OF RECORD COPY

(PCT Rule 24.2(a))

To:

CALDERBANK, T., Roger
Mewburn Ellis
York House
23 Kingsway
London, Greater London WC2B 6HP
United Kingdom

RECEIVED
18 AUG 2003

RECORDS ENT'D ....
RECORDS SEEN ....
DIARY ENT'D ....
~~RENEWAL ENT'D X~~ ....
ALREADY ENT'D ....

Date of mailing (day/month/year) 06 August 2003 (06.08.03)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference DRHFP6155139	International application No. PCT/GB03/03000

The applicant is hereby notified that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

LEVINGSTON, Gideon(all designated States)

International filing date	:	10 July 2003 (10.07.03)
Priority date(s) claimed	:	12 July 2002 (12.07.02)
Date of receipt of the record copy by the International Bureau	:	04 August 2003 (04.08.03)
List of designated Offices	:	

AP :GH,GM,KE,LS,MW,MZ,SD,SL,SZ,TZ,UG,ZM,ZW
EA :AM,AZ,BY,KG,KZ,MD,RU,TJ,TM
EP :AT,BE,BG,CH,CY,CZ,DE,DK,EE,ES,FI,FR,GB,GR,HU,IE,IT,LU,MC,NL,PT,RO,SE,SI,SK,TR
OA :BF,BJ,CF,CG,CI,CM,GA,GN,GQ,GW,ML,MR,NE,SN,TD,TG
National :AE,AG,AL,AM,AT,AU,AZ,BA,BB,BG,BR,BY,BZ,CA,CH,CN,CO,CR,CU,CZ,DE,DK,DM,DZ, EC,EE,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,JP,KE,KG,KP,KR,KZ,LC,LK,LR,LS,LT,LU, LV,MA,MD,MG,MK,MN,MW,MX,MZ,NI,NO,NZ,OM,PH,PL,PT,RO,RU,SC,SD,SE,SG,SK,SL,TJ,TM,TN, TR,TT,TZ,UA,UG,US,UZ,VC,VN,YU,ZA,ZM,ZW

ATTENTION

The applicant should carefully check the data appearing in this Notification. In case of any discrepancy between these data and the indications in the international application, the applicant should immediately inform the International Bureau.

In addition, the applicant's attention is drawn to the information contained in the Annex, relating to:

- [X] time limits for entry into the national phase - **see updated important information (as of April 2002)**
- [X] confirmation of precautionary designations (if applicable)
- [X] requirements regarding priority documents (if applicable)

A copy of this Notification is being sent to the receiving Office and to the International Searching Authority.

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland** Facsimile No. (41-22) 338.87.40	Authorized officer: Carine SEVILLANO (Fax 022 338 87 40) Telephone No. (41-22) 338 9254

INFORMATION ON TIME LIMITS FOR ENTERING THE NATIONAL PHASE

The applicant is reminded that the **"national phase" must be entered** before each of the designated Offices indicated on the cover sheet of this Notification by paying national fees and furnishing translations, as prescribed by Articles 22 and 39 and the applicable national laws. In addition, the applicant may also have to comply **with other special requirements** applicable in certain Offices. It is the **applicant's responsibility** to ensure the necessary steps to enter the national phase are taken in a timely fashion. Most Offices do not issue reminders to applicants in connection with the entry into the national phase.

The **applicable time limit** for entering the national phase will, **subject to what is said in the following paragraph**, be **30 MONTHS** from the priority date, not only in respect of any elected Office where a demand for international preliminary examination is filed before the expiration of 19 months from the priority date (see Article 39(1)), but also in respect of any designated Office, in the absence of filing of such demand, where Article22(1) as modified with effect from 1 April 2002 applies in respect of that designated Office. For further details, see PCT Gazette No. 44/2001 of 1 November 2001, pages 19926, 19932 and 19934, as well as the PCT Newsletter, October and November 2001 and February 2002 issues.

In practice, **time limits other than the 30-month time limit will continue to apply**, **for various periods of time**, in respect of certain designated or elected Offices. For **regular updates on the applicable time limits (20, 21, 30 or 31 months, or other time limit)**, Office by Office, refer to the PCT Gazette("Section IV" part published on a weekly basis), to the PCT Newsletter (on a monthly basis) and to the relevant National Chapters in Volume II of the PCT Applicant's Guide (the paper version of which is updated usually twice a year and the Internet version of which is updated usually on a weekly basis). Finally, a cumulative table of all applicable time limits for entering the national phase is available from WIPO's Internet site, via links from various pages the site including those of the Gazette, Newsletter and Guide, at http://www.wipo.int/pct/en/index.html.

Information about the requirements for **filing a demand for international preliminary examination** is set out in the PCT Applicant's Guide, Volume I/A, Chapter IX. Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination (at present, all PCT Contracting States are bound by Chapter II).

CONFIRMATION OF PRECAUTIONARY DESIGNATIONS

This notification lists only specific designations made under Rule 4.9(a) in the request. It is important to check that these designations are correct. Errors in designations can be corrected where precautionary designations have been made under Rule 4.9(b). The applicant is hereby reminded that any precautionary designations may be confirmed according to Rule 4.9(c) before the expiration of 15 months from the priority date (this time limit may not be extended). If it is not confirmed, it will automatically be regarded as withdrawn by the applicant. There will be no reminder and no invitation. Confirmation of a designation consists of the filing of a notice specifying the designated State concerned (with indication of the kind of protection or treatment desired) and the payment of the designation and confirmation fees. The Notice of confirmation and payment must reach the receiving Office within the 15-month time limit.

REQUIREMENTS REGARDING PRIORITY DOCUMENTS

For applicants who have not yet complied with the requirements regarding priority documents, the following is recalled.

Where the priority of an earlier national, regional or international application is claimed, the applicant must submit a copy of the said earlier application, certified by the authority with which it was filed ("the priority document") to the receiving Office (which will transmit it to the International Bureau) or directly to the International Bureau, before the expiration of 16 months from the priority date, provided that any such priority document may still be submitted to the International Bureau before that date of international publication of the international application, in which case that document will be considered to have been received by the International Bureau on the last day of the 16-month time limit (Rule 17.1(a)).

Where the priority document is issued by the receiving Office, the applicant may, instead of submitting the priority document, request the receiving Office to prepare and transmit the priority document to the International Bureau. Such request must be made before the expiration of the 16-month time limit and may be subjected by the receiving Office to the payment of a fee (Rule 17.1(b)).

If the priority document concerned is not submitted to the International Bureau or if the request to the receiving Office to prepare and transmit the priority document has not been made (and the corresponding fee, if any, paid) within the applicable time limit indicated under the preceding paragraphs, any designated State may disregard the priority claim, provided that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within the time limit which is reasonable under the circumstances.

Where several priorities are claimed, the priority date to be considered for the purposes of computing the 16-month time limit is the filing date of the earliest application whose priority is claimed.

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

To:

CALDERBANK, T., Roger
Mewburn Ellis
York House
23 Kingsway
London, Greater London ~~WC2B 6HP~~
United Kingdom

RECEIVED
11 SEP 2003

NOTIFICATION CONCERNING SUBMISSION OR TRANSMITTAL OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

RECORDS ENT'D ....
RECORDS SEEN ....
DIARY ENT'D ....
RENEWAL ENT'D X ....
ALREADY ENT'D ....

Date of mailing (day/month/year) 03 September 2003 (03.09.03)	
Applicant's or agent's file reference DRHFP6155139	**IMPORTANT NOTIFICATION**
International application No. PCT/GB03/03000	International filing date (day/month/year) 10 July 2003 (10.07.03)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 12 July 2002 (12.07.02)
Applicant LEVINGSTON, Gideon	

1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).

2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.

3. An asterisk(*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

4. The letters "NR" appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
12 July 2002 (12.07.02)	02/08802	FR	29 Augu 2003 (29.08.03)

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland** Facsimile No. (41-22) 338.87.40	Authorized officer Abderrazak LAAROUSSI Telephone No. (41-22) 338 9999

Form PCT/IB/304 (July 1998) 005834620

From the INTERNATIONAL BUREAU

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:

CALDERBANK, T., Roger
Mewburn Ellis
York House
23 Kingsway
London, Greater London WC2B 6HP
ROYAUME-UNI

RECEIVED
- 2 FEB 2004
MEWBURN ELLIS

Date of mailing *(day/month/year)* 22 January 2004 (22.01.2004)	
Applicant's or agent's file reference DRHFP6155139	IMPORTANT NOTICE

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB2003/003000	10 July 2003 (10.07.2003)	12 July 2002 (12.07.2002)

Applicant: LEVINGSTON, Gideon

1. Notice is hereby given that the International Bureau has **communicated**, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this notice:

   AU, AZ, BY, CH, CN, CO, DE, DZ, EP, HU, JP, KG, KP, KR, MD, MK, MZ, RU, TM, US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:

   AE, AG, AL, AM, AP, AT, BA, BB, BG, BR, BZ, CA, CR, CU, CZ, DK, DM, EA, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, ID, IL, IN, IS, KE, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MG, MN, MW, MX, NI, NO, NZ, OA, OM, PG, PH, PL, PT, RO, SC, SD, SE, SG, SK, SL, SY, TJ, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW

   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-*bis*)).

3. Enclosed with this notice is a copy of the international application as published by the International Bureau on 22 January 2004 (22.01.2004) under No. WO 2004/008259

4. **TIME LIMITS for filing a demand for international preliminary examination and for entry into the national phase**

   The applicable time limit for entering the national phase will, **subject to what is said in the following paragraph**, be **30 MONTHS** from the priority date, not only in respect of any elected Office if a demand for international preliminary examination is filed before the expiration of **19 months** from the priority date, but also in respect of any designated Office, in the absence of filing of such demand, where Article 22(1) as modified with effect from 1 April 2002 applies in respect of that designated Office. For further details, see *PCT Gazette* No. 44/2001 of 1 November 2001, pages 19926, 19932 and 19934, as well as the *PCT Newsletter*, October and November 2001 and February 2002 issues.

   In practice, **time limits other than the 30-month time limit** will continue to apply, for various periods of time, in respect of certain designated or elected Offices. For **regular updates on the applicable time limits** (20, 21, 30 or 31 months, or other time limit), Office by Office, refer to the *PCT Gazette*, the *PCT Newsletter* and the *PCT Applicant's Guide*, Volume II, National Chapters, all available from WIPO's Internet site, at http://www.wipo.int/pct/en/index.html.

   For filing a **demand for international preliminary examination**, see the *PCT Applicant's Guide*, Volume I/A, Chapter IX. Only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination (at present, all PCT Contracting States are bound by Chapter II).

   It is the applicant's sole **responsibility** to monitor all these time limits.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.(41-22) 740.14.35	Authorized officer Gijsbertus Beijer - Carlos Roy Telephone No.(41-22) 338.91.11